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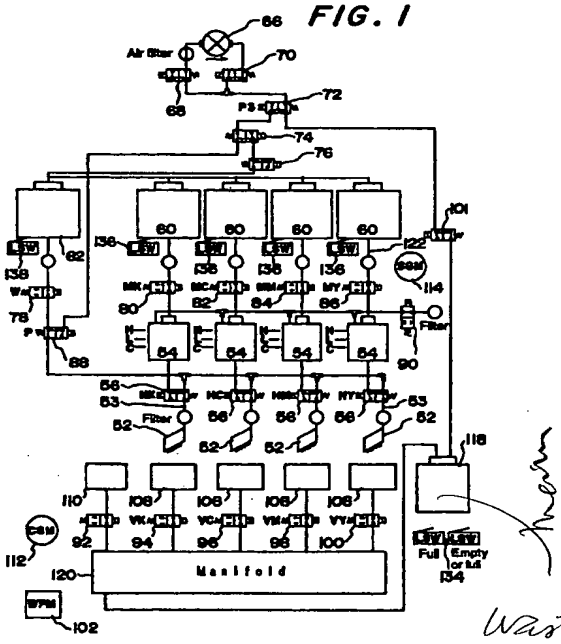
(54) Ink jet printer and method for operating the same

(57) An ink jet printer and a method for operating the same are proposed. The ink jet printer is designed to perform high quality drafting or printing, while minimizing the contact of ink with the atmosphere. Ink jet type recording heads (52) and sub tanks (54) of the ink jet printer are mounted on a movable carriage (40) of the printer. The sub tanks supply the recording heads with ink. Main tanks (60) are located stationary at the printer body and supply the sub tanks with ink. Ink can be recycled from the sub tanks into the main tanks and removed from the recording heads into a waste solution tank (118). Afterwards, the ink in the main tanks can be stirred, and the recording heads can be cleaned with a cleaning solution and subsequently dried by air. Preferably, an atmosphere release valve (90) is associated to the sub tanks. This valve is basically only opened during drafting or printing. In particular, the valve is closed after the sub tanks have been filled or refilled with ink from the main tanks or after ink from the sub tanks has been recycled into the main tanks.

FIG. 1



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Description

[0001] The present invention relates to ink jet printers, and more particularly, it relates to ink jet printers in which sub tanks are mounted at the side of recording heads, and main tanks are provided at the side of the printer body, and ink filled in the main tanks supplied to the sub tanks and recording is carried out by the recording heads of ink jet type. In particular the present invention relates to an ink jet printer according to the preamble of claim 1 or 9 and to a method according to the preamble of claim 10 or 16.

[0002] JP H 10-86395 A discloses an ink jet printer in which sub tanks for ink are mounted at the side of recording heads. Main tanks for ink are mounted at the printer body side. Ink is supplied from the main tanks to the sub tanks. Then, the ink is supplied from the sub tanks to the recording heads and is discharged from the recording heads to the paper for drafting or printing.

[0003] JP H 05-294528 A discloses an ink jet printer in which the paper is guided onto a large diameter platen roller, wherein the printing is carried out by the ink jet head on this platen roller.

[0004] Regarding the ink for recording on the paper, a solvent ink has heretofore been known. This solvent ink has an advantageous point that the recorded surface keeps its ink stuck to the surface since the ink is fully dissolved therein. For this reason, there is no necessity of coating a protective film such as a lamination on the recording surface on which the recording is applied with the solvent ink.

[0005] However, the solvent ink has an alcoholic ingredient that has high volatility which is easily dried up as compared with aqueous ink, but on the other hand, it instantly becomes solid. Also, there is a quality that if it remains as it is the pigment ingredient separates. Accordingly, in order to use such solvent ink and other easily volatile inks for use in the ink jet printers, a sealing feature is required in whole of ink supply paths, and basically, contact of the ink with atmosphere should be prevented as much as possible, and evaporation of the ink must be prevented. For this purpose, there is a need for keeping the ink in the recording heads, tubes, sub tanks for a long period of time. Furthermore, unless the ink is periodically stirred and mixed, there is an apprehension that the ink ingredient tends to separate.

[0006] Object of the present invention is to solve the foregoing points and to provide or enable a high quality drafting or printing with an ink that has a minimum contact with atmosphere and has high volatility, in particular wherein the ingredients of the ink tend to separate.

[0007] The above object is achieved by an ink jet printer according to claim 1 or 9 or a method according to claim 10 or 16. Preferred embodiments are subject of the subclaims.

[0008] In particular, ink jet type recording heads and sub tanks are mounted at the side of a Y cursor, and main tanks are disposed at the side of the printer body. When the drafting/printing is completed or the printer is in standby for drafting, the ink in the sub tanks is recovered or recycled into the main tanks, and the ink in the recording heads is recovered or guided into a waste solution tank. After the ink in the sub tanks is recovered or recycled the main tanks and/or generally before the ink in the main tanks is supplied into the sub tanks, the ink in the main tanks is stirred. After the ink in the recording heads is recovered or recycled the waste solution tank, the insides of the recording heads are cleaned with a cleaning solution, and after the cleaning, air is supplied into the recording heads, and the inside of the recording heads is dried up. An atmosphere release valve is provided for the sub tank, and after filling the ink into the recording head, the atmospheric release valve is closed except for the drafting time and the supply/discharge operation of the ink into the sub tanks, and thus, the ink in the sub tanks is prevented from evaporation.

[0009] Further aspects, features and advantages of the present invention will be explained with reference to the enclosed drawing of a preferred embodiment. It shows:

- Fig. 1 a piping scheme showing an ink supply system of a plotter;
- Fig. 2 an essential part of the plotter;
- Fig. 3 an ink stirring mechanism;
- Fig. 4 a flow chart of a complete ink supply system;
- Fig. 5 a flow chart of an ink filling operation;
- Fig. 6 a flow chart of an ink supply operation;
- Fig. 7 a flow chart of a cleaning operation;
- Fig. 8 a flow chart of an ink recovery operation;
- Fig. 9 a flow chart of a head cleaning operation;
- Fig. 10 a flow chart of a head cleaning operation;
- Fig. 11 a flow chart of an ink pressure feeding operation; and
- Fig. 12 a flow chart of a capping suction operation.

[0010] The construction of the present invention will be described hereinafter in detail by referring to the attached drawing.

[0011] In Fig. 2, numeral 22 denotes legs (another is omitted) disposed at right and left of a substrate or base 26 of an ink jet printer 24, and the substrate or base 26 is fixed to the upper ends thereof. The legs 22

and the substrate or base 26 constitute the printer body of the ink jet printer 24. At the upper parts of the legs 22, a shaft holder 28 is fixed, and a shaft portion of a roll paper holder 32 to which a roll portion 30a of a roll of paper 30 is detachably fixed is rotatably and detachably journalled on the shaft holder 28. The base 26 is connected with a platen 34 (paper guide plate). In the vicinity of an upper flow end of the platen 34, a guide roller 36 is disposed whose length is almost same as the width of the roll of paper 30 extending in Y axis direction. The guide roller 36 is disposed in the upper part of the roll portion 30a of the roll of paper 30, and both ends of the guide roller 36 are rotatably journalled at the base 26 through a bracket. Numeral 38 denotes an Y axis rail, which is disposed horizontally in the upper part of the platen 34, and both ends are journalled on the base 26 through the bracket. An Y cursor or carriage 40 is shiftably mounted on the Y axis rail 38, and the Y carriage 40 is interlinked with an Y axis drive device (not shown) disposed on the base 26 through a steel belt 42 or the like. A slit is formed on the platen 34 along the Y axis direction, and a drive roller 44 is disposed in the slit. Both ends of the drive roller 44 are rotatably journalled at the base 26 through the bracket, and the drive roller 44 is interlinked with an X axis drive device (not shown) disposed on the base 26. A pinch roller shaft 46 is mounted on the Y axis rail 38 through a spring mechanism (not shown) liftably, and pinch rollers 48 fixed rotatably to the pinch roller shaft 46 are to be set either in a condition where it separates from the surface of the drive roller 44 and a condition where it is in contact at a level and springy towards the surface or biased against the drive roller 44.

[0012] A head base 50 is fixed to one side of the Y carriage 40, and four ink jet recording heads 52 each of which has multiple heads or nozzles are mounted at the head base 50. On the other side of the Y carriage 40, four sub tanks 54 are mounted for solvent ink of four colours (black K, cyan C, magenta M, yellow Y) whose number being equal to the number of the recording heads 52. On the upper cover of the sub tanks 54, an electromagnetic valve 56 is mounted. A sensor for detecting the level of the ink is mounted on each sub tank 54. The sub tanks 54 are connected with its respective recording heads 52 by tubes 53. In order to keep a negative pressure in the ink supply path, namely the tubes 53, upper openings of the sub tanks 54 are disposed lower than discharge vents of the ink of the corresponding recording heads 52.

[0013] Numeral 58 denotes a main tank case disposed at the base 26, and four main tanks 60 for four colour solvent inks, whose number is equal to those of the sub tanks 54, and a cleaning solution tank 62 are detachably housed in case 58. Each tank 60, 62 is constructed in such way that an ink remaining quantity can be detected by sensors 136, 138 consisting of limit switches disposed beneath each tank 60, 62 which are supported by springs.

[0014] Numeral 64 denotes a supply controller mounted at the base 26, and in which a pump 66 and electromagnetic valves 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 101 are built in its inside, and moreover, an electronic control circuit unit is provided which controls this electronic equipment. Also, a controller (not shown) for controlling the X and Y axis drive devices and recording heads 52 and the like is mounted at the base 26 of the printer 24.

[0015] It is noted that the working direction of the pump 66 can be changed by means of valves 68 and 70. In combination with other valves shown in Fig. 1 the filling, supply, removal (recovering), cleaning and drying operations for the heads 52, tubes 53 and the sub tanks 54 and the like, in particular as mentioned below, can be performed.

[0016] Numeral 102 denotes a wiper motor, and 104 denotes a wiper for cleaning the discharge vents of the recording heads 52. Numeral 106 denotes a purge box having a rubber cap 108 for closing the discharge vents of the recording heads 52 and an ink waste vent 110 alternately. The purge box 106 is disposed at a side portion outside of the drafting range of the base 26 and is liftable by means of a motor 112. Each cap 108 of the purge box 106 and waste vent 110 are connected to a manifold 120 fixed to the base 26 through tubes and electromagnetic valves 92, 94, 96, 98, 100.

[0017] Numeral 114 denotes a motor for stirring the ink in the main tanks 60, and 116 denotes a waste solution tank case mounted on leg body 22, and 118 denotes a waste solution tank. The waste solution tank 118 is supported by springs housed in a case 116, and the quantity of the ink can be detected by sensors 134 consisting of limit switches disposed between the bottom portion of the tank 118 and the upper surface of the case 116.

[0018] On the bottom portion of each main tank 60, as shown in Fig. 3, rotors 2 made from a magnetic material are rotatably journalled On the base 26, pulleys 4 are rotatably journalled for each main tank 60, and a magnet 8 is fixed to each pulley 4. Among four pulleys 4, a shaft 6 of one pulley 4 is connected to an output of the motor 114. Between each pulley 4, endless wire ropes 10, 12, 14 are spanned, and each pulley 4 is mutually interlocked.

[0019] Each of the component parts and the devices are connected by piping made of tubes as shown in Fig. 1. The recording heads 52 can shift immediately above the purge box 112 that is off the drafting range by shifting of the Y carrier 40 along the Y axis rail 38.

[0020] The operation of the embodiment of the present invention will be described in the following.

[0021] To set a feed unit of the roll of paper 30 on the platen 34, the pinch roller 48 is lifted to feed the paper 30 from the roll unit 30a, and the paper 30 that is fed therefrom is inserted between the drive roller 44 and the pinch rollers 48, and thereafter, the pinch rollers 48

are descended to be in resilient contact with the drive roller 44 with the paper 30 inbetween. In this arrangement, the setting of the paper is completed.

[0022] When the setting of the paper is completed, and the printer 24 enters into its drafting or printing mode, the controller performs an ink filling operation as shown in the flow chart of Fig. 4, and thereafter, shifts to the drafting operation. When the drafting starts, the feed portion of the paper 30 is carried in an arrow direction (A) over the platen 34 by intermittent rotation of the drive roller 44 in one direction. Also, the recording heads 52 are driven on the basis of an image information by the control of the controller, and ink is discharged, and the feed portion of the paper 30 is scanned along the Y axis by the reciprocating shift of the Y carrier 40 along the Y axis rail 38, and the image information being spread in the memory of the controller is printed on and visible from the surface of the paper 30.

[0023] When a piece element (a nozzle or the like) of a recording head 52 discharges ink, the piece element or respective recording head 52 sucks the ink automatically from the sub tank 54 proportional to the quantity of the suction. In this case, if the sub tank 54 is not set at the negative pressure, the recording head 52 sucks the ink excessively and the ink overflows from the discharge outlet of the nozzle of the recording head 52. To set the sub tank 54 at the negative pressure, the embodiment of this invention sets the position level of the bottom surface of the sub tanks 54 lower than the discharge outlets of the recording heads 52.

[0024] When the drafting operation is completed, judgement of whether or not the sub tanks 54 have (enough) ink is made by a signal of the sensor, and if no-ink judgement is made, the operation shifts to an ink supply operation. After the ink supply, or if the judgement that the sub tanks have (enough) ink is made, the control judges whether or not a fixed time has passed after the drafting, and if the judgement is affirmative, the operation shifts to a cleaning operation. In case the set time has not passed after the cleaning or the drafting, the control judges if the set time passed or not from the drafting completion or in the standby condition, and the control judges negative, the operation returns to the drafting operation. Also, if the judgement is affirmative, the operation shifts sequentially to an ink recovery operation and a head cleaning operation.

[0025] Next, the (initial) ink filling operation will be described by referring to flow chart of Fig. 5.

[0026] The controller performs the ink pressure feeding and the capping suction sequentially as will be described after shifting to the ink filling operation. By the foregoing operation, ink is filled or pressed into the sub tanks 54, and the inside of the recording heads 52 and the tubes 53 connecting the heads and sub tanks become empty. Next, in the condition where the electromagnetic valves 68, 70, 72, 101 are switched to the suction side, the electromagnetic valves 56 are changed over to the ink suction direction to drive the pump 66.

[0027] In this manipulation, the inside of the waste solution tank 118 is set on negative pressure, and the recording heads 52 suck ink from the sub tanks 54. The controller detects the quantity of ink in the sub tanks 54, and when a predetermined quantity of ink has been supplied to the recording heads 52 from the sub tanks 54, the suction of the pump 66 stops. In this manipulation, the filling of ink into the recording heads 52 is completed. At this time, the electromagnetic valve 92 for the waste vent 110 is closed.

[0028] After the pump 66 stops the suction, the motor 112 drives to descend the purge box 106, and the cap 108 removes from the recording head 52, and the Y carrier 40 shifts to the drafting position along Y axis rail 38. Next, the waste solution tank electromagnetic valve 101 and the cap electromagnetic valves 92, 94, 96, 98, 100 are released to atmosphere. In this manipulation, the ink in the cap 108 drops freely into the manifold 120.

[0029] Next, the ink supply operation shown in Fig. 4 will be described by referring to flow chart of Fig. 6.

[0030] The recording heads 52 are driven and ink is discharged from nozzles of the heads 52 and the drafting is carried out. Next, the judgement is made as to if the drafting is completed or not, and in case the judgement is negative, the judgement is made if the sub tanks 54 have no or not enough ink. In case the judgement is made that there is no or not enough ink in the sub tanks, the operation shifts to the pressure feeding operation as will be described hereinafter, and returns to the drafting operation after supplying ink to the sub tanks 54.

[0031] Next, the cleaning operation shown in Fig. 4 will be described by referring to flow chart of Fig. 7.

[0032] After the capping suction operation to be described hereinafter, the purge box 106 descends to separate the recording heads 52 from the caps 108, and the recording heads 52 shift to the drafting position. Next, the waste solution tank electromagnetic valve 101 and the electromagnetic valves 92, 94, 96, 98, 100 are released to atmosphere and the ink in the caps 108 is freely dropped in the manifold 120.

[0033] Next, the ink recovery operation shown in Fig. 4 will be described by referring to flow chart of Fig. 8.

[0034] In the first place, the controller changes over the pump electromagnetic valves 68, 70 in the suction direction, and changeover the sub tank atmosphere release electromagnetic valve 90 to atmosphere. Furthermore, it opens the electromagnetic valves 80, 82, 84, 86 between main tanks and sub tanks, and drives the pump 66, and sucks the ink in the sub tanks 54 into the main tanks 60. Next, the controller judges if there is any remaining ink in the sub tanks 54 after passing of the set time. When it judges that there is the ink in the sub tanks 54, the display unit of the controller shows the error, and shifts to the error correction.

[0035] In case the judgement is made that there is no ink in the sub tanks 54, it drives the pump 66 for a

predetermined time, and sucks the ink in the sub tanks 54 into the main tanks 60, and thereafter, stops the pump 66. In this condition, the ink in the sub tanks 54 and tube cables 122 between the sub tanks 54 and the main tanks 60 is recovered or recycled into the main tanks 60. Next, the electromagnetic valves 56 and the sub tank atmosphere release valve 90 are shut out. Next, it drives the motor 114 and rotates the magnets 8, so that the ink in the main tanks 60 is stirred for a predetermined time by driving the motor 114 and rotating the magnets 8 to rotate the rotors 2 in the main tanks 60 by means of the inertia of the magnetic force.

[0036] Next, the capping suction operation is performed which will be described later. Next, the caps 108 are removed from the recording heads 52, and the waste solution electromagnetic valve 101 and the cap electromagnetic valves 92, 94, 96, 98, 100 are released to atmosphere. In this operation, the ink in the caps 108 is freely dropped into the manifold 120.

[0037] The head cleaning operation shown in Fig. 4 will be described by referring to flow charts of Fig. 9 and Fig. 10.

[0038] In the first place, the error correction is performed by judging if there is any remaining quantity or not in the cleaning tank 62 on the basis of the signal of the sensor 138 and displaying the absence of any remaining quantity in the cleaning tank 62 on the display unit if there is no remaining quantity therein.

[0039] In case the judgement is made that there is any remaining quantity, the recording heads 52 shift immediately above the waste vent 110 of the purge box 106. Next, the pump electromagnetic valves 68, 70 change over to pressure feeding direction. Next, the inter pump and main tank electromagnetic valves 72, 76, 74 and the head electromagnetic valve 56 and the cleaning tank electromagnetic valves 78, 88 change over to the cleaning tank direction. Next, it drives the pump 66 and pressure feeds cleaning solution from tank 62 into the recording heads 52 for a predetermined time (about 30 seconds).

[0040] Next, the head air electromagnetic valves 74, 88 change over to the air feeding direction. Next, it drives the pump 66 and feeds air into the recording heads 52 for a predetermined time (about 5 seconds), and dries the inside of the recording heads 52.

[0041] Next, the controller judges how many times the air feeding drying operation has been carried out, and makes a judgement that it reaches a predetermined number of times (about 5 times), and stops the drive of the pump 66.

[0042] Next, wiping is carried out by shifting the recording heads 52 to the wiping position. The wiping is carried out by using one piece of the wiper 104 five times. The wiper motor 102 strikes at the stopper by turning in counter clockwise direction. If there is electrical possibility at the initial, the original position is determined by turning counter clockwise direction with current down. In this condition, normally, this position is maintained since the wiper 104 is at a position of not rubbing the recording heads 52.

[0043] In one wiping operation, the following ABCDE operation takes place:

A. Confirming that the wiper motor 102 is at the original point.
B. Shifting the Y carriage 40 in the scanning direction to a position in which the recording head 52 can be wiped.
C. Rotating the wiper motor 102 in clockwise direction at 72 degrees.
D. Shifting the Y carriage 40 in the direction of the caps 108.
E. Rotating the wiper motor 102 in counter lockwise direction at 72 degrees.

[0044] When the wiping is completed, the recording heads 52 shift over the caps 108, and the recording heads 52 are pushed against the caps 108.

[0045] Next, the cleaning tank electromagnetic valves 78, 88 are changed over in the cleaning tank direction, and the electromagnetic valve 76 between the pump and the cleaning tank is released to atmosphere. Next, the recording heads 52 are driven for a predetermined time, and the cleaning solution is discharged from the nozzles. The capping suction operation to be described later follows. The caps 108 are separated from the recording heads 52. Next, the waste solution tank electromagnetic valve 101 and the cap electromagnetic valves 92, 94, 96, 98, 100 are released to atmosphere. In this operation, the cleaning solution in the caps 108 freely drop into the manifold 102.

[0046] Next, the ink pressure feeding operation shown in Fig. 5 and Fig. 6 will be described by referring to flow chart of Fig. 11.

[0047] In the first place, the controller judges if there is any remaining quantity of ink in the main tanks 60 or not on the basis of the signals of the sensors 136, and in case it judges negatively, the display unit displays that no quantity remains in the main tanks, and shifts to the error correction. When it judges affirmatively, it changes over the pump electromagnetic valves 68, 70 in the pressure feeding direction, and changes over the electromagnetic valves 72, 76, 74 between the pump and the main tanks in the pressure feeding direction. Also, it opens the electromagnetic valves 80, 82, 84, 86 between the main tanks 60 and sub tanks 54 and drives the pump 66 and pressure feeds ink into the sub tanks 54.

[0048] Next, the controller judges if any low limit level in the sub tanks 54 is detected by the signals of the level sensors or judges if a predetermined time (about 10 seconds) has passed, and judges affirmatively, stops the drive of the pump 66, and releases the electromagnetic valve 76 between the pump and the main tanks to atmosphere. In this operation, the ink freely drops from the main tanks 60 into the sub tanks 54 for 30 seconds.

In case, the upper limit level sensors in the sub tanks 54 do not detect upper limits within this time, it generates an error.

[0049] To shut out the atmosphere release of the main tanks 60 at the time when sufficient ink has been supplied to the sub tanks 54 normally, the electromagnetic valve 76 is shut out and also, the electromagnetic valves 80, 82, 84, 86 between the main tanks and sub tanks are closed.

[0050] If the drafting or printing is not carried out at the time of this point, an atmosphere release valve 90 of the sub tanks 54 is closed to prevent evaporation of ink ingredients in the sub tanks 54. In other words, the atmosphere release valve 90 of this sub tanks 54 is kept closed except for the case when the drafting is carried out, during the capping suction and cleaning as well as when the recording heads 52 are in the action.

[0051] Next, the capping operation shown in Fig. 5, Fig. 8 and Fig. 10 will be described by referring to flow chart of Fig. 12.

[0052] The controller, in the first place, judges that the waste solution tank 118 is full or not on the basis of the signal of the sensor 134, and in case it judges affirmatively, it displays that the waste solution tank is full and shifts to the error correction. In case of negative judgement, it shifts the recording heads 52 immediately above the caps 108. Next, it changes over the pump electromagnetic valves 68, 70 in the suction direction, and changes over the electromagnetic valves 72, 101 between the pump and the waste solution tank in the suction direction.

[0053] Next, the controller drives the motor 112 to elevate the purge box 106, and pushes the caps 108 against the recording heads 52 and closes the nozzles of the recording heads 52 with the caps 108. In this condition, the electromagnetic valves 56 remain closed. Also, the cap electromagnetic valves 94, 96, 98, 100 remain open and the waste vent electromagnet valve 92 remains closed.

[0054] Next, the controller drives the pump 66 to keep the inside of the waste solution tank 118 at negative pressure, and sucks the ink in the recording heads 52, including the ink in the tubes 53 spanning between the recording heads 52 and the electromagnetic valves 56 to the waste solution tank 118 side.

[0055] The controller stops the drive of the pump 66 after a lapse of a predetermined time, and suspends the ink suction operation from the recording head 52. Upon the suspension of operation, the inside of the recording head 56 and the inside of the tube 53 become empty.

[0056] The present invention has been constructed as described in the foregoing so that it can perform drafting or printing of high quality even though it uses ink of high volatility with ingredients that can easily separate.

[0057] An ink jet printer and a method for operating the same are proposed. The ink jet printer is designed to perform high quality drafting or printing, while minimizing the contact of ink with the atmosphere. Ink jet type recording heads and sub tanks of the ink jet printer are mounted on a movable carriage of the printer. Main tanks are located stationary at the printer body. Ink can be recycled from the sub tanks into the main tanks and removed from the recording heads into a waste solution tank. Afterwards, the ink in the main tanks can be stirred, and the recording heads can be cleaned with a cleaning solution and subsequently dried by air. Preferably, an atmosphere release valve is associated to the sub tanks. This valve is basically only opened during drafting or printing. In particular, the valve is closed after the sub tanks have been filled or refilled with ink from the main tanks or after ink from the sub tanks has been recycled into the main tanks.

Claims

1. Ink jet printer (24) with a movable carriage (40) carrying at least one recording head (52) and at least one sub tank (54) for supplying the associated recording head (52) with ink, and with at least one preferably stationary main tank (60) for supplying the associated sub tank (54) with ink,
   characterized in
   that ink is removable from the recording head (52), from a tube (53) interconnecting the sub tank (54) with its associated recording head (52) and/or from the sub tank (52) in the condition of completion of a drafting or printing operation, in case of a standby mode and/or when turning off the ink jet printer (24).

2. Ink jet printer according to claim 1, characterized in that ink removed from the sub tank(s) (54) and/or from the tube(s) (53) can be recycled into the associated main tank(s) (60).

3. Ink jet printer according to claim 1 or 2, characterized in that a waste solution tank (118) is provided, and that ink removed from the recording head(s) (54) and/or from the tube(s) (53) can be supplied into the waste solution tank (118).

4. Ink jet printer according to any one of the preceding claims, characterized in that in case of recovering ink in the sub tank (54) to the side of the main tank (60) ink in a tube (122) connected to the sub tank (54) can be recovered to the side of the main tank (60), and in case ink in the recording head (52) of recovering to the side of a waste solution tank (118) ink in a tube (53) connected to the recording head (52) can be guided to the side of a waste solution tank (118).

5. Ink jet printer according to any one of the preceding claims, characterized in that a stirring mechanism is provided for stirring ink in the main tank(s) (60), in

particular after recycling of ink into the main tank(s) (60) and/or before supplying ink to the associated sub tank(s) (54).

6. Ink jet printer according to any one of the preceding claims, characterized in that the inside of the recording head(s) (52) can be cleaned with a cleaning solution after removing ink from the recording head(s) (52) into a waste solution tank (118).

7. Ink jet printer according to any one of the preceding claims, characterized in that air can be supplied to the recording head(s) (52), in particular after cleaning the recording head(s) (52) with a cleaning solution for drying the inside of the recording head(s) (52).

8. Ink jet printer according to any one of the preceding claims, characterized in that a pump (66) is provided for supplying ink from the main tank(s) (60) into the associated sub tank(s) (54) and/or filling the recording head(s) (52) with ink as well as for removing ink from the recording head(s) (52), the tube(s) (53) and/or from the sub tank(s) (52)

9. Ink jet printer (24), preferably according to any one of the preceding claims, with a movable carriage (40) carrying at least one recording head (52) and at least one sub tank (54) for supplying the associated recording head (52) with ink, and with at least one preferably stationary main tank (60) for supplying the the associated sub tank (54) with ink,
characterized in
that an atmosphere release valve (90) is provided in or connected to the sub tank (54), preferably multiple sub tanks (54), wherein the atmosphere release valve (90) can be closed for preventing evaporation of any ink ingredient.

10. Method for operating an ink jet printer (24) comprising a movable carriage (40) carrying at least one recording head (52) and at least one sub tank (54) for supplying the associated recording head (52) with ink, and comprising at least one preferably stationary main tank (60) for supplying the the associated sub tank (54) with ink,
characterized in
that ink is preferably automatically removed from the recording head (52), from a tube (53) interconnecting the sub tank (54) with its associated recording head (52) and/or from the sub tank (52) when a drafting or printing operation has been completed, after a predetermined standby time and/or when turning off the ink jet printer (24).

11. Method according to claim 10, characterized in that ink removed from the sub tank(s) (54) and/or from the tube(s) (53) is recycled into the associated main tank(s) (60).

12. Method according to claim 10 or 11, characterized in that ink removed from the recording head(s) (54) and/or from the tube(s) (53) is be supplied into a waste solution tank (118).

13. Method according to any one of claims 10 to 12, characterized in that the ink in the main tank(s) (60) is stirred, in particular after recycling of some ink into the main tank(s) (60) and/or and before supplying ink from the main tank(s) (60) to the sub tank(s) (54).

14. Method according to any one of claims 10 to 13, characterized in that the inside of the recording head(s) (52) is cleaned with a cleaning solution after removing the ink therefrom.

15. Method according to claim 14, characterized in that air is supplied to the recording head(s) (52) after the cleaning the inside thereof for drying them.

16. Method for operating an ink jet printer (24), preferably according to any one of claims 10 to 15, the ink jet printer (24) comprising a movable carriage (40) carrying at least one recording head (52) and at least one sub tank (54) for supplying the associated recording head (52) with ink, and comprising at least one preferably stationary main tank (60) for supplying the associated sub tank (54) with ink,
characterized in
that an atmosphere release valve (90) associated to the sub tank(s) (54)is closed after filling ink into the recording head(s) (52) except during drafting or printing and except during supply and removal of ink to and from the sub tank(s) (54).

FIG. 1

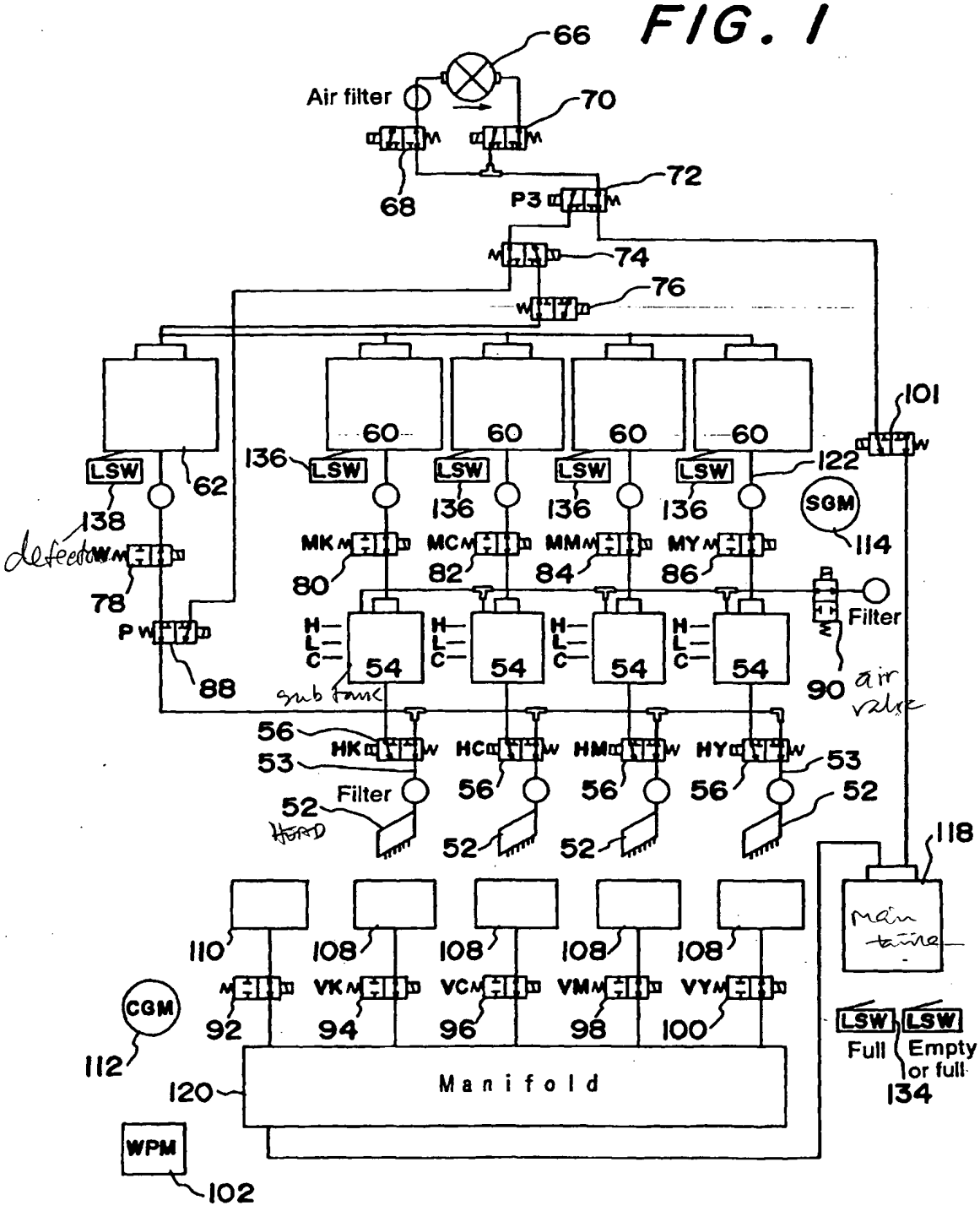


FIG. 2

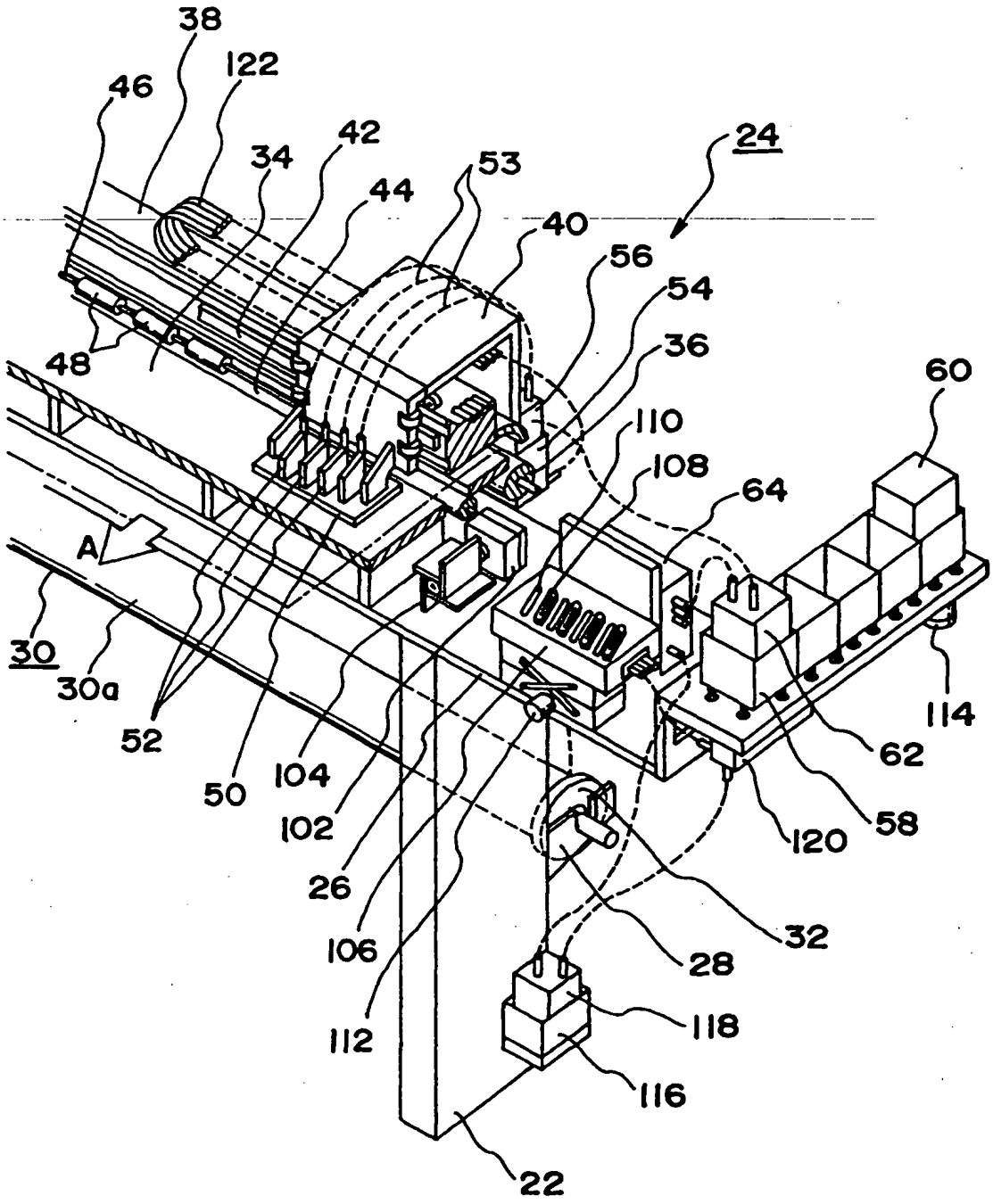


FIG. 3

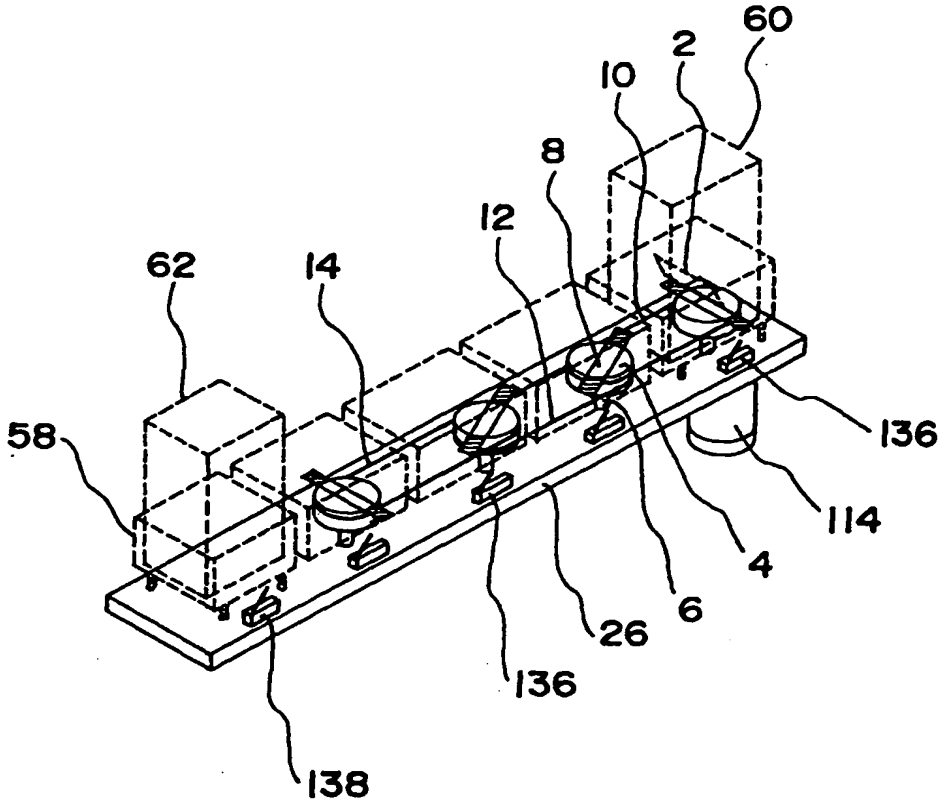


FIG. 4

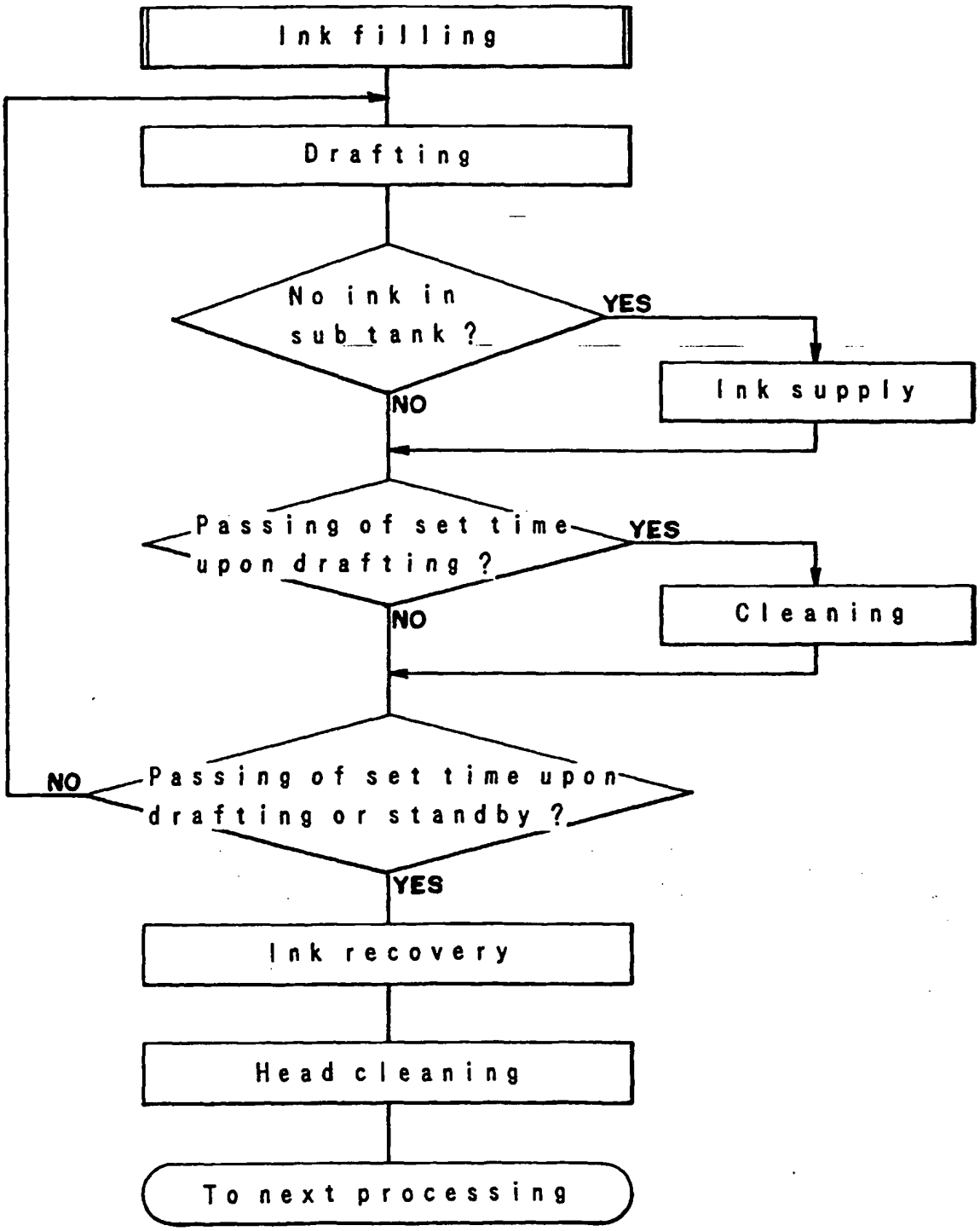


FIG. 5

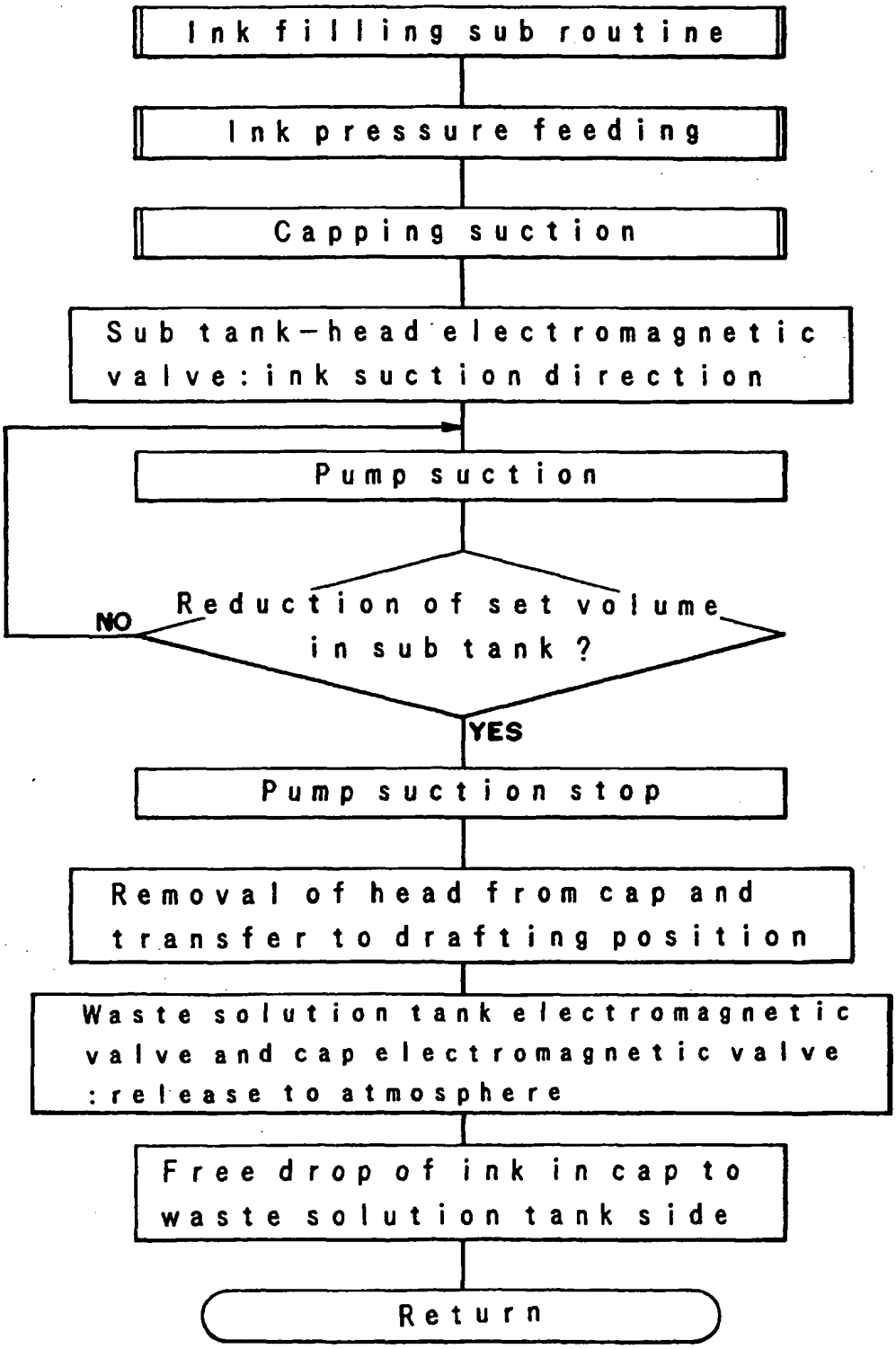


FIG. 6

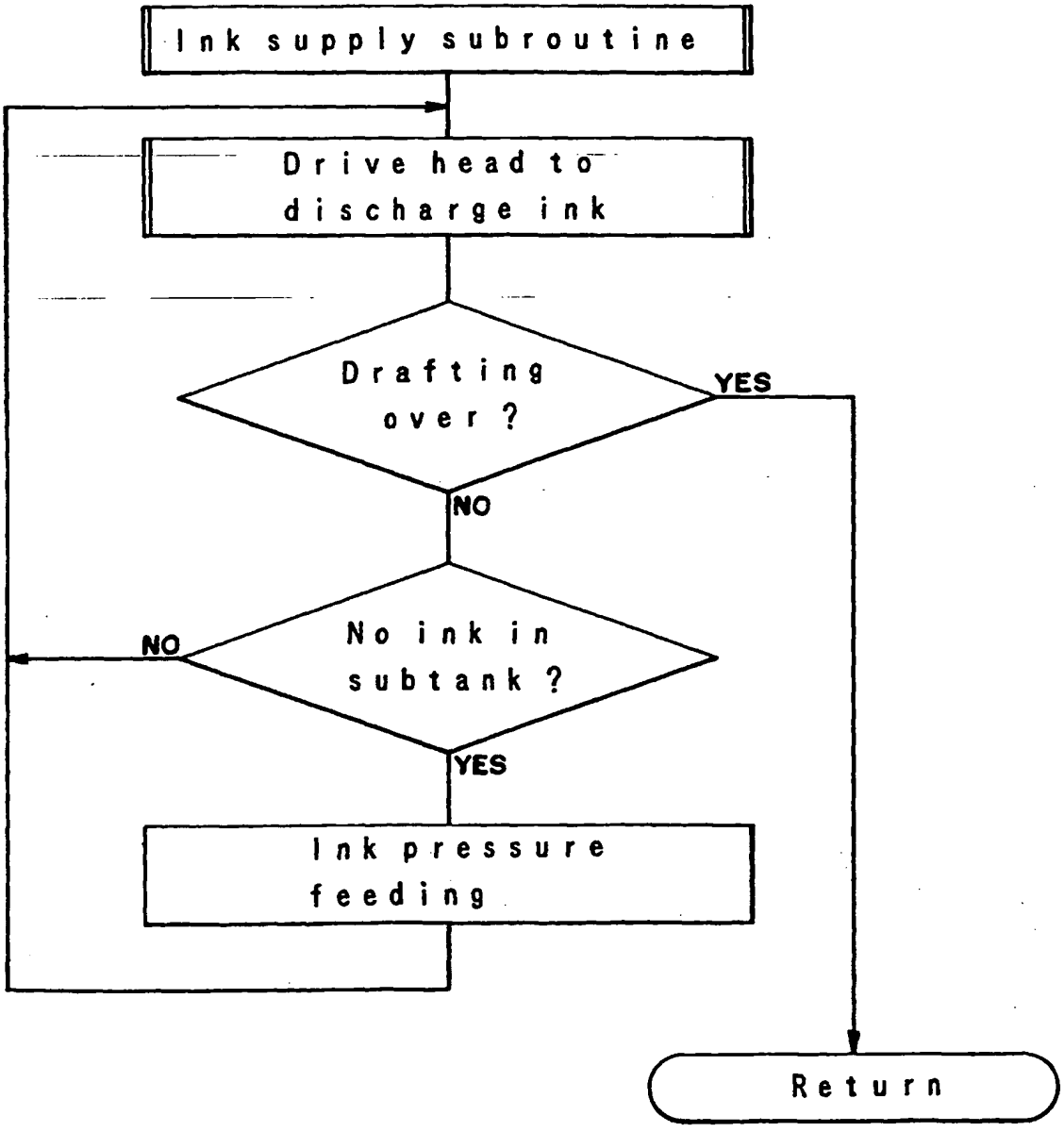


FIG. 7

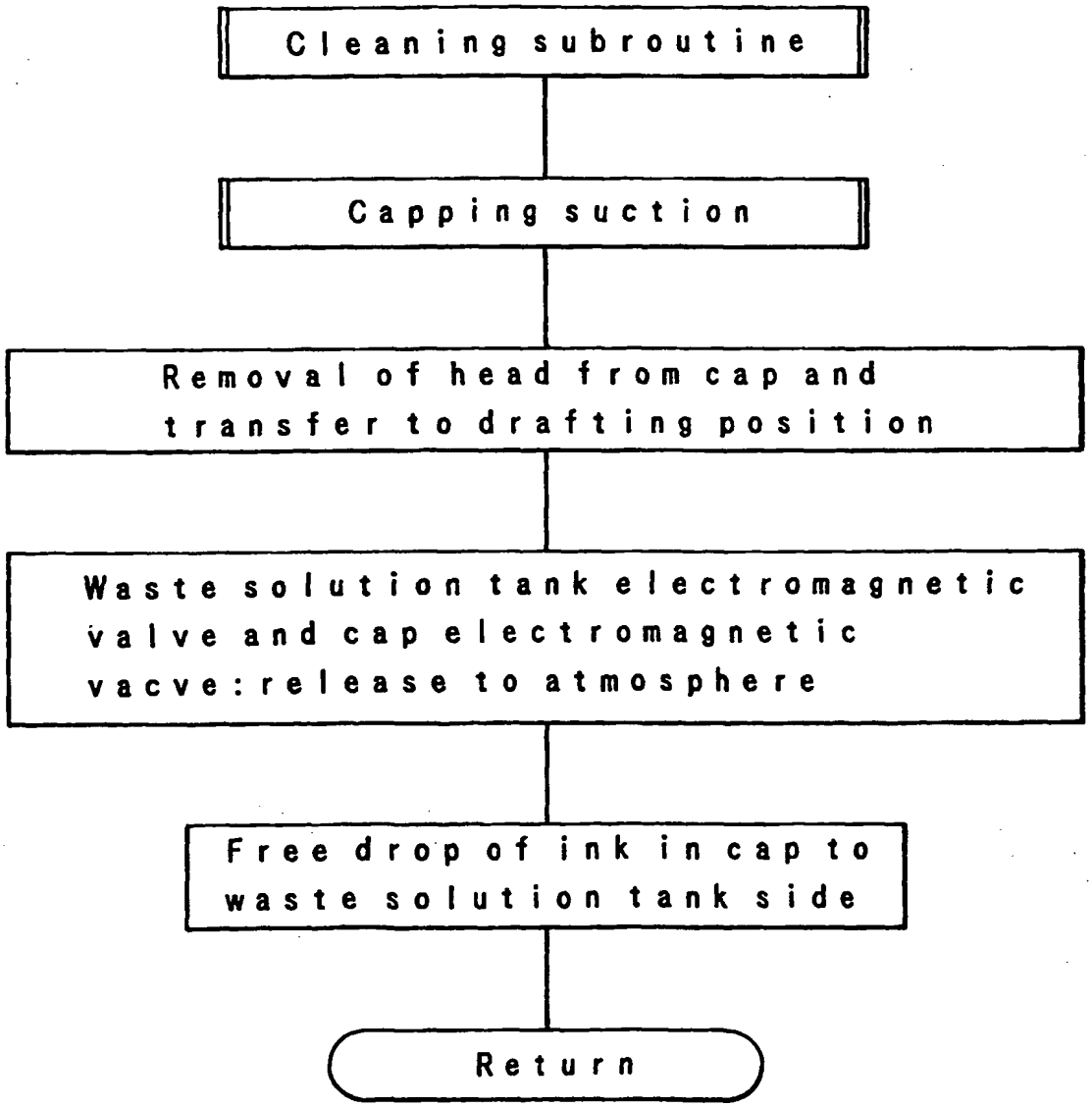


FIG. 8

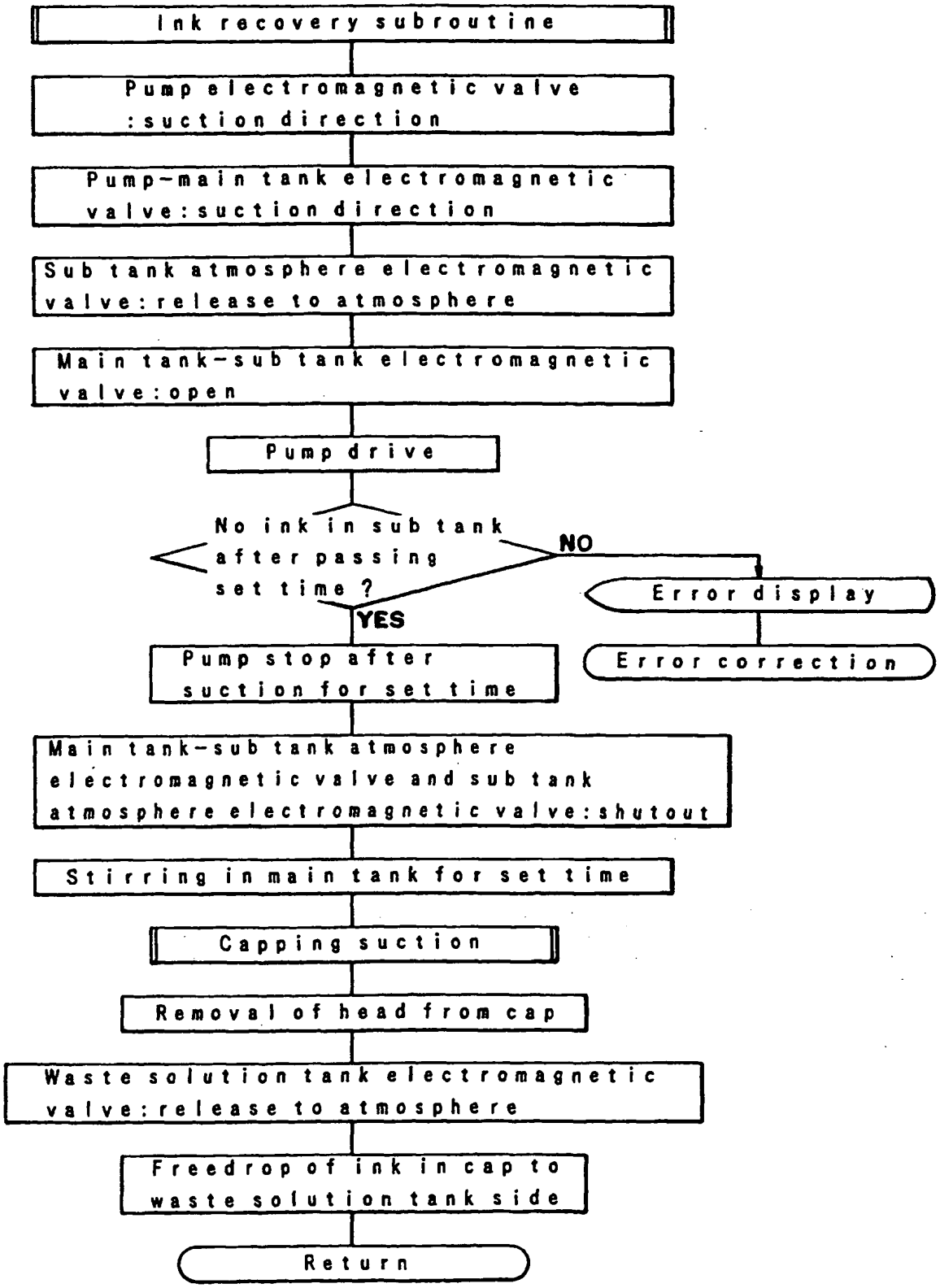


FIG 9

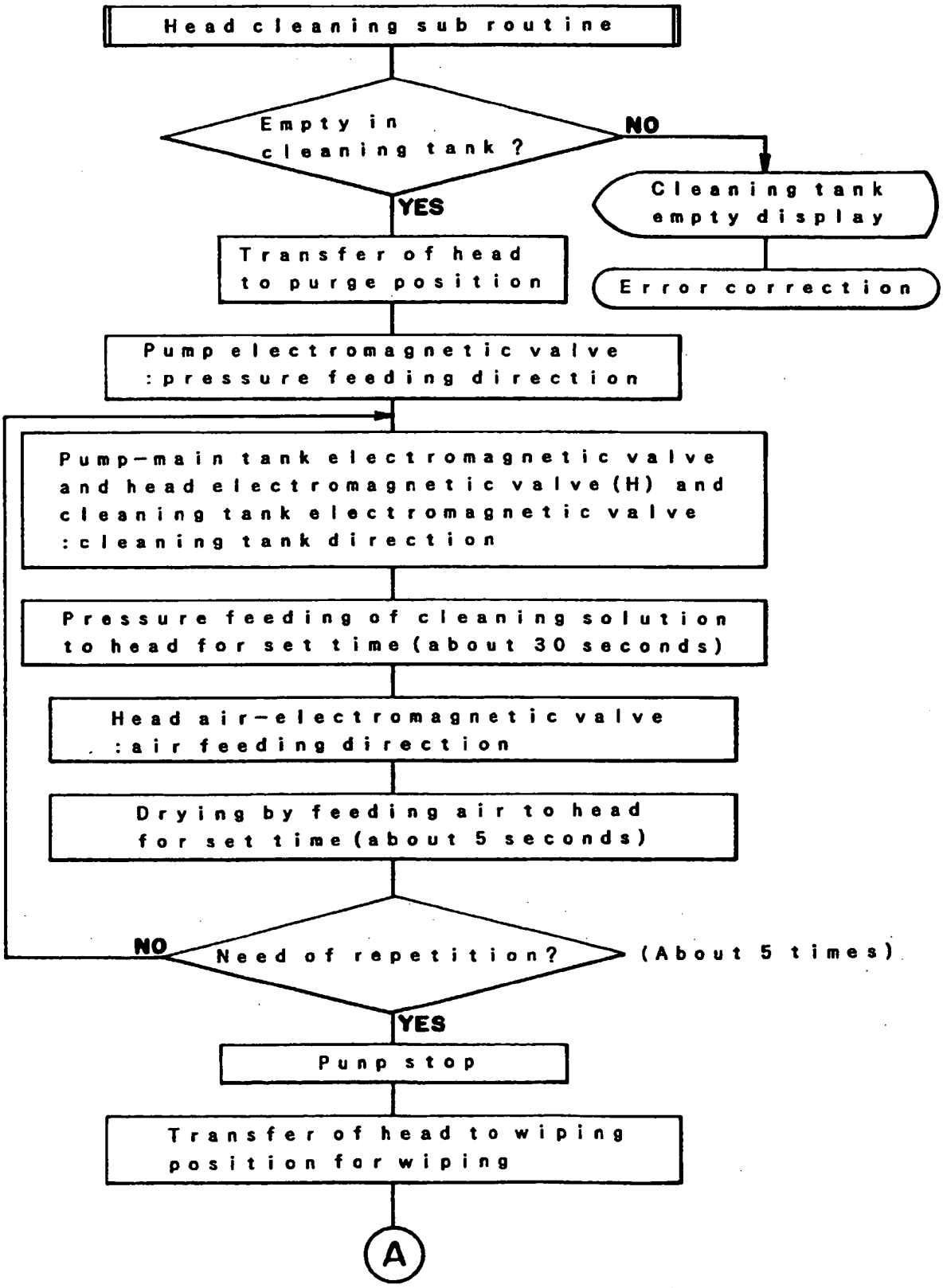


FIG. 10

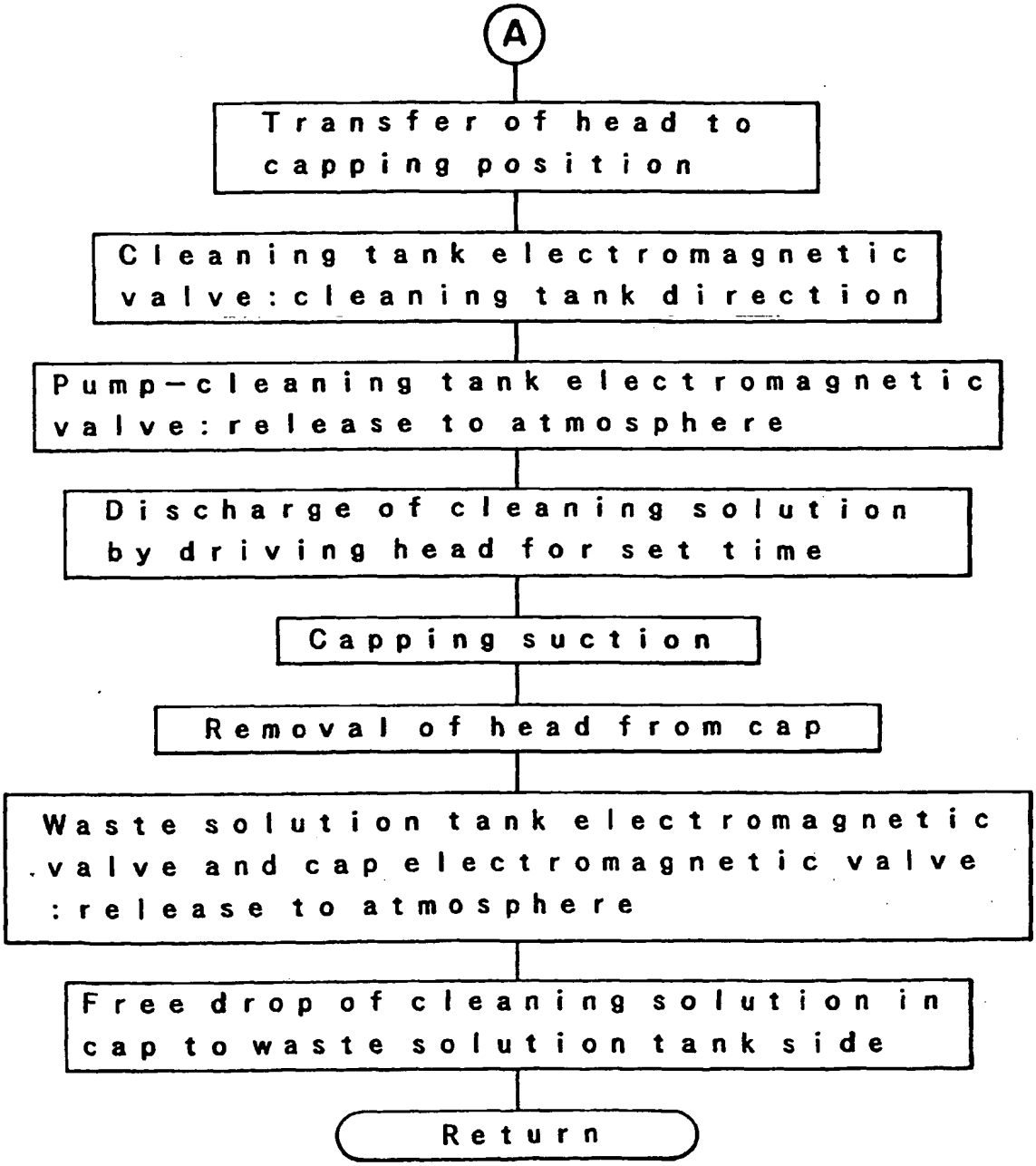


FIG. 11

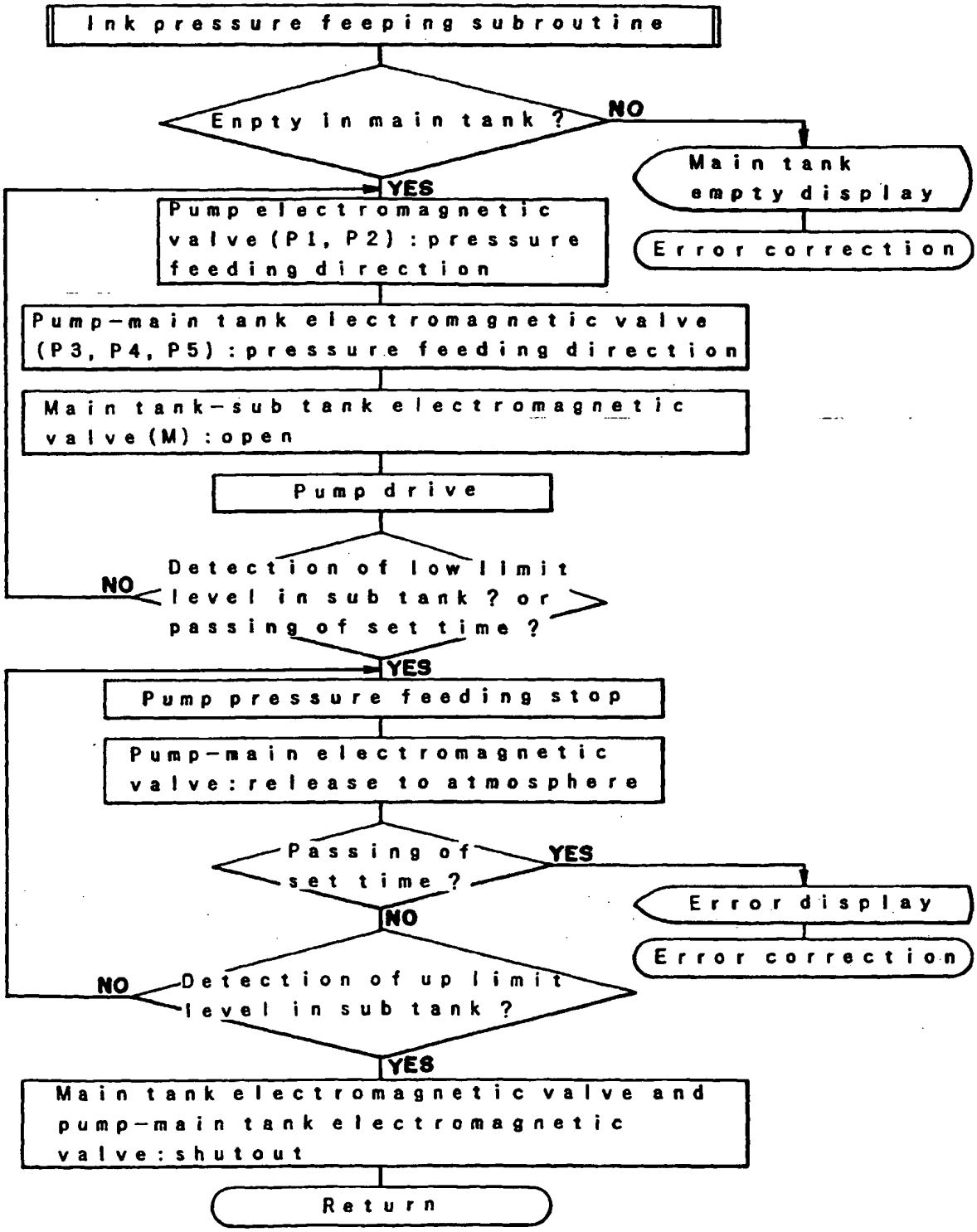
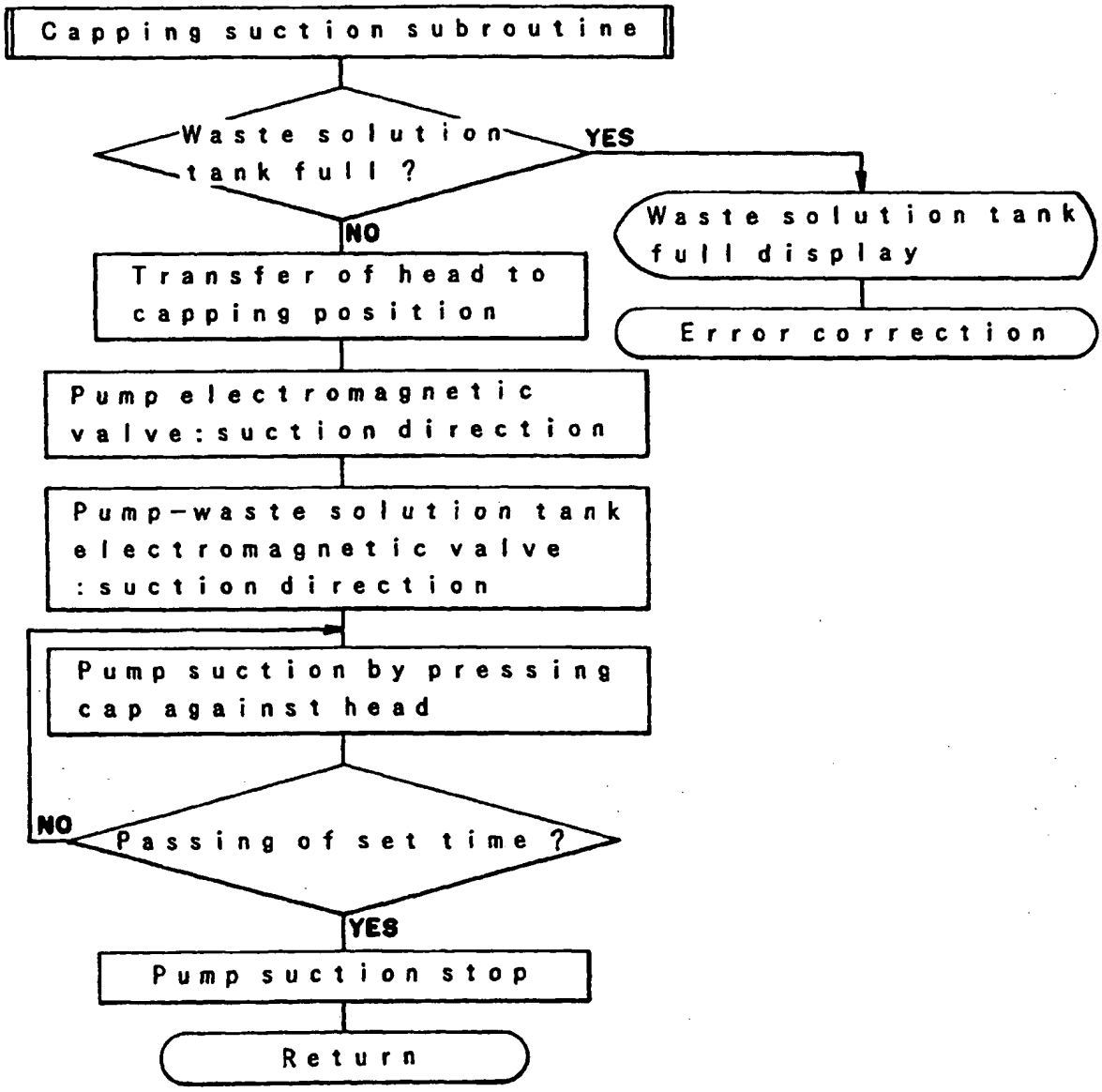


FIG. 12



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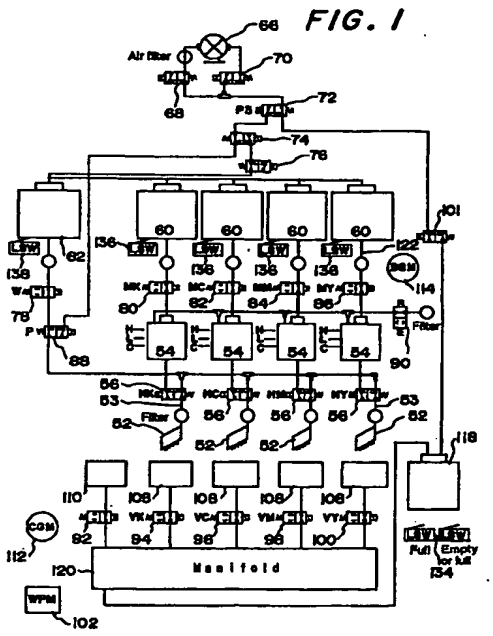
(54) Ink jet printer and method for operating the same

(57) An ink jet printer and a method for operating the same are proposed. The ink jet printer is designed to perform high quality drafting or printing, while minimizing the contact of ink with the atmosphere. Ink jet type recording heads (52) and sub tanks (54) of the ink jet printer are mounted on a movable carriage (40) of the printer. The sub tanks supply the recording heads with ink. Main tanks (60) are located stationary at the printer body and supply the sub tanks with ink. Ink can be recycled from the sub tanks into the main tanks and removed from the recording heads into a waste solution tank (118). Afterwards, the ink in the main tanks can be stirred, and the recording heads can be cleaned with a cleaning solution and subsequently dried by air. Preferably, an atmosphere release valve (90) is associated to the sub tanks. This valve is basically only opened during drafting or printing. In particular, the valve is closed after the sub tanks have been filled or refilled with ink from the main tanks or after ink from the sub tanks has been recycled into the main tanks.

FIG. 1



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EUROPEAN SEARCH REPORT

Application Number
EP 00 10 4018

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 4 494 124 A (WILLIAMS THEODORE F ET AL) 15 January 1985 (1985-01-15) * column 5, line 13 - column 6, line 5 * * column 8, line 55 - column 9, line 16 * * figure 1 *	1,2,7,8, 10,11,15	B41J2/175 B41J2/17
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	2 August 2000	Papastefanou, E

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